

TWO NEW SPECIES OF FRESHWATER CRAYFISH (CRUSTACEA: DECAPODA: PARASTACIDAE) FROM NORTHEASTERN QUEENSLAND RAINFOREST

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Two new species of freshwater crayfish, *Cherax parvus*, and *Euastacus yigara*, are described and illustrated from the upper Tully R. catchment in simple notophyll vine forest, on the Cardwell Ra. *C. parvus* sp.nov. has several morphological features unique to the genus, and does not appear closely related to any extant species, suggesting a long period of geographic isolation. *E. yigara* sp.nov. most closely resembles *E. balanensis* Morgan, 1988, known from the nearby Lamb and Bellenden Ker Ranges, and can be distinguished by the morphology of the first chelipeds and carapace. Keys are provided to Queensland species of *Cherax* and *Euastacus*. □Crustacea, Parastacidae, *Cherax*, *Euastacus*, Queensland, northeastern Australia, freshwater, rainforest, taxonomy, morphology, biology, biogeography, survival status.

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Six species of parastacid freshwater crayfish, all belonging to the genus *Euastacus*, are currently considered endemic to wet highland areas (>800 m elevation) in north and mid-eastern Queensland (Morgan, 1991). No Australian species of *Cherax* has been considered endemic to wet upland or highland areas and most records have been from elevations less than 400 m (Riek, 1951, 1969; Short, 1991, 1993a). In the highlands of New Guinea a distinctive *Cherax* species-group comprising nine species is endemic to the Wissel Lakes area (Holthuis, 1949, 1950). The discovery of a new species of *Cherax* in an upland/highland, rainforest catchment in north-eastern Queensland, occurring sympatrically with an undescribed *Euastacus* and two undescribed freshwater shrimps, is of considerable interest.

*Cherax parvus* sp.nov. and *E. yigara* sp.nov. were discovered during a Queensland Museum expedition to the upper Tully River area in November 1992. The primary purpose of the expedition was to collect fully-developed, adult males of an undescribed species of *Macrobrachium* (presently being studied as part of a revision of Australian species by J.S.) and obtain habitat data for an undescribed *Caridina* (described as *C. zebra* Short, 1993), previously known from the area. These new shrimps were first collected by Dr S. Bunn and Mr M. Bray, Griffith University, during a limnological study for the proposed Tully-Millstream hydroelectric scheme in 1990.

MATERIAL AND METHODS

All material examined is housed in the Queensland Museum collection unless otherwise stated. Measurements were made using vernier callipers and line drawings with the aid of a camera lucida. Photographs were taken with a 35 mm SLR camera and flashes.

The terms 'cheliped' and 'chela' refer to the first pereiopod unless stated otherwise. *Euastacus* terminology largely follows Morgan (1986), particularly spination and sternal keel characters. Colour patterns, habitats and burrow types for Queensland *Cherax* are derived from the work of Riek (1951, 1969), Horwitz & Richardson (1986) and personal observations by J.S. Rainforest and climatic zone terms follow Webb & Tracey (1981).

Physico-chemical habitat data were obtained using a TPS LC82 dissolved oxygen meter, mercury thermometer, Merck Universalindikator pH 0-14 paper, and an Aquasonic water hardness test kit. Altitudes were estimated from the Australia 1:100 000 topographic survey map series R631.

Abbreviations used in text: QM, Queensland Museum; OCL, carapace length from orbital margin to dorsolateral invagination of posterior margin; T, thoracic sternite, T6, thoracic sternite six etc., imm., immature; P, pereiopod; Pr, sternal keel processes, Pr1, first sternal keel processes, etc; Qld, Queensland; N.T., the Northern Territory.

## SYSTEMATICS

***Cherax parvus* sp.nov.**  
(Figs 1-4)

## MATERIAL EXAMINED

**HOLOTYPE:** QM W18121, ♂ (22.7 mm OCL), O'Leary Ck, tributary of the Tully R. above Koombooloomba Dam, 17°50.7'S, 145°37.7'E, in short phreatic burrows under rocks, rocks/sand substratum, leaf litter, fallen timber, low to moderate flow, water clarity high, fringing simple notophyll vine forest, pH 5.5, hardness <10 ppm, water temperature 20°C, dissolved oxygen 6 ppm, altitude c. 750 m, water depth 0.1-0.3 m, 06/11/1992, J. Short, P. Davie.

**PARATYPES:** QM W18123, ♀ (14.0 mm OCL), upper Tully R. near Old Culpa above Koombooloomba Dam, 17°55.5'S, 145°37.6'E, amongst leaf litter, rocks/sand substratum, fallen timber, low to moderate flow, water clarity high, fringing simple notophyll vine forest, pH 5.5, hardness <10 ppm, water temperature 18°C, dissolved oxygen 5.8 ppm, altitude c. 720 m, water depth 1 m, netted, 06/11/1992, J. Short, P. Davie; QM W18133, 6♂♂ (12.4-21.9 mm OCL), 2♀♀ (12.6, 16.0 mm OCL), imm. (9.9 mm OCL), same collection data as holotype except collected from short phreatic burrows under rocks in small, clay bottomed pool above main creek; QM W17494, 10♂♂ (9.0-16.6 mm OCL), 4♀♀ (8.3-14.4 mm OCL), same locality and habitat data as holotype, water depth 0.1-0.5 m, 06/11/1992, J. Short, P. Davie.

## DESCRIPTION OF MALE HOLOTYPE

**Cephalothorax.** Carapace punctate; slender, breadth c. 0.5 X CL (0.5-0.6 in paratypes), depth c. 0.6 X CL (0.5-0.6 in paratypes); cephalon with few tubercles ventrally; branchiostegites uninflated, with few indistinct tubercles along ventral cervical groove.

Rostrum slender, triangular, tapering strongly in distal third, length c. 1.4 X breadth (1.0-1.6 in paratypes), reaching distal penultimate segment of antennular peduncle, dorsally flattened, not recurved distally, punctate along inner margins of lateral carinae, smooth medially, setose distally near acumen; lateral carinae moderately developed, commencing at base of rostrum, terminating at acumen, without tubercles or spines; ventro-lateral margins setose; acumen blunt, upturned (strongly in paratypes).

Post-orbital carinac almost obsolete, unarmed anteriorly, excavated with well separated punctations, commencing close to orbital margin of carapace, medially curved anteriorly, diverging posteriorly; cervical groove setose (setation less developed in smaller paratypes); branchiocardiac grooves obsolete.

Eyes with cornea large, globular, well pig-

mented; eyestalks largely concealed by rostrum. Scaphocerite length slightly exceeding length of rostrum, broadest at mid-length; lamina broadly rounded mesially, lateral margin terminating in well developed spine. Antennal peduncle setose ventrally, coxocerite acute anteriorly, basicerite without lateral spine (acute in smaller paratypes).

Epistome strongly concave medially, setose anteriorly (densely setose in paratypes), with distinct tubercles laterally, lateral margins entire. Mouthparts without unique features for genus. Branchial formula typical for genus (cf. Holthuis, 1949) with posterior arthrobranch above P4 reduced. Pleurocoxal lappets well developed; operculiform; fringed with long plumose setae; lappet between P4-5 unusually thin, circular, plumose setae very long.

Sternal keel sharp posteriorly, more rounded anteriorly, lateral processes setose, without obvious pores, Pr4 juxtaposed, Pr5 similar.

**Chelipeds.** First chelipeds large, chela length exceeding carapace length (shorter in juvenile paratypes), distal merus reaching end of scaphocerite (carpus reaching end of scaphocerite in juvenile paratypes), isomorphic.

Outer margin of chela moderately convex; fingers slightly gaping (without gape in undeveloped paratypes); opposing edges densely setose ventrally with pollex setation continuing onto manus, bearing rounded teeth, one tooth large and prominent on dactylus at mid-length, similar slightly smaller tooth on pollex (teeth isomorphic in paratypes); pollex broad basally, evenly tapering; dactylus broadest at mid-length, equal to manus in length; manus moderately broad, breadth equal to length (greater than length in juveniles), dorsum slightly convex longitudinally, strongly convex laterally, mesial margin serrations continuing onto distal half.

Carpus bearing large broad uncinat mesial spine (missing on left cheliped), angle of disto-ventral condyle not produced into spine or tubercle, ventro-mesial angle similar, followed by few tubercles postero-mesially, disto-mesial angle glabrous, disto-dorsal condyle strongly developed, enlarged laterally to form broad sclerotinous plate.

Merus of typical shape, dorsal carina without obvious tubercles or spines (small distal tubercle in paratypes), ventral surface sparsely setose, with numerous strong cuticular processes, one or two larger than remainder.

## COLOUR

Body dark brown; first chelipeds dark brown



FIG.1. *Cherax parvus* sp.nov., QM W18121, ♂ holotype (22.7 mm OCL).

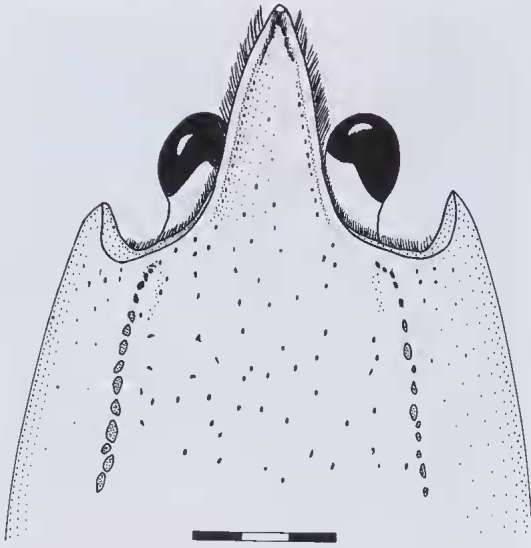


FIG.2. *Cherax parvus* sp.nov., QM W18121, ♂ holotype, anterior carapace and rostrum. Scale bar divisions in millimetres.

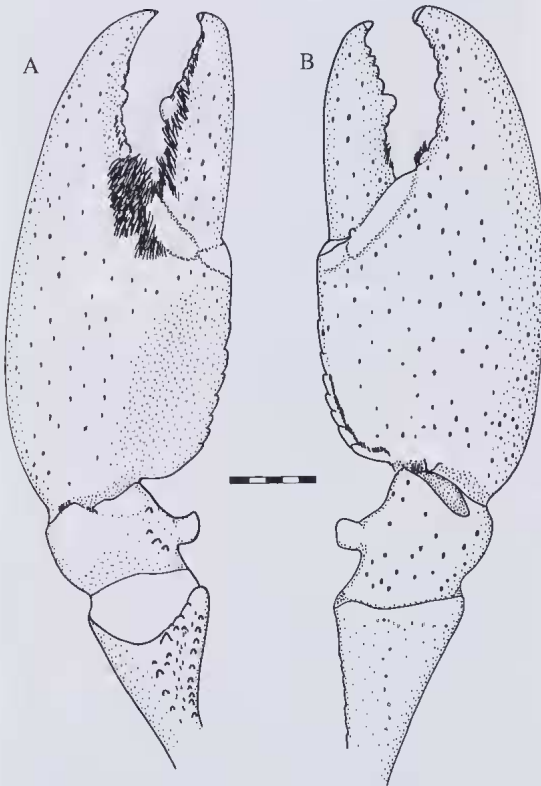


FIG.3. *Cherax parvus* sp.nov., QM W18121, ♂ holotype, A. ventral first right cheliped. B. dorsal first left cheliped. Scale bar divisions in millimetres.

disto-dorsally with reticulated pattern on manus, fingertips orange, proximal merus and ischium orange, ventral manus and fingers cream; second chelipeds and ambulatory legs greenish-cream dorsally, light cream ventrally.

#### BIOLOGY

Freshwater, short phreatic burrows under rocks or amongst leaf litter in shallow open water (1 m), rocks/sand or clay substrates, fringing simple notophyll vine forest, 720-750 m altitude, zero to moderate flow, water clarity high. Recorded physico-chemical tolerances: pH 5.5, hardness <10 ppm, water temperature 18-20°C, dissolved oxygen 5.8-6.0 ppm.

Close association of this species with rainforest is suggested by its absence in Nitchaga Ck, another tributary of the Tully R., above Tully Falls. This creek drains open sclerophyll forest and dries to a series of pools during extended dry periods (as in November 1992, when sampled). Here it is replaced by a species of the wide-ranging 'depressus' complex (sensu Riek, 1951).

This is the smallest species so far described in the genus. The holotype, which has a post-orbital body length of only 55 mm and a post-orbital carapace length of 23 mm, shows the robust, broad chelae with an obvious gape, and the well developed dentition on the opposing margins of the fingers, characteristic of a well developed male. Of the 24 paratypes only two exceed 17 mm in post-orbital carapace length.

At the type locality *C. parvus* is sympatric with *E. yigara* sp.nov., *Caridina zebra* Short, 1993, and an undescribed *Macrobrachium*.

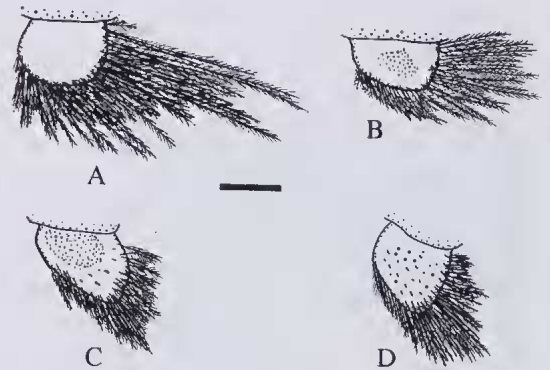


FIG.4. *Cherax parvus* sp.nov., QM W18133, ♂ paratype (17.4 mm OCL), pleurocoxal lappets. A. P4-5. B. P3-4. C. P2-3. D. P1-2. Scale bar 1 millimetre.

## DISTRIBUTION

Recorded from the upper Tully R. and its tributary, O'Leary Ck, above Koombaloo Dam, at 720-750 m altitude, Cardwell Ra., NEQ.

## SURVIVAL STATUS

Probably secure. Although abundant at the type locality, more data is required on the distribution of the species and its relative abundance at other sites. Only one specimen was collected in the main Tully R. at Old Culpa where the substrate was clean sand. Two higher elevation sites (c. 900 m), approx. 12 km past O'Leary Ck, travelling east on the main forestry road, failed to produce crayfish, although *C. zebra* Short, 1993, was very abundant. Both sites had a silty sand substratum and the fringing vegetation showed indications of regrowth, possibly as a result of timber logging.

## ETYMOLOGY

Latin (adjective), meaning small.

## SYSTEMATIC POSITION

The distribution of *Cherax* in the humid tropics of north Queensland is shown in Fig. 5. Although records of the new species lie within the broad geographical range of '*C. depressus*' (sensu Riek, 1951), *C. parvus* does not appear closely related to that complex. The following unique features suggest a long period of geographic isolation.

1. The almost obsolete post-orbital carinae commencing very close to the orbital carapace margin.

2. The disto-dorsal condyle on the carpus of the first chelipeds very strongly developed and enlarged laterally to form a broad sclerotinous plate.

3. The pleurocoxal lappet between P4-5 unusually thin and fringed with very long plumose setae.

4. The branchiostegites uninflated in developed specimens.

With regard to the last character, inflated branchiostegites and narrow areolae are generally correlated with the enlargement of the branchial chambers and increased surface area of gills. This is most pronounced in fully grown adults of species living in poorly oxygenated habitats. The relatively small branchial chambers of *C. parvus* may reflect its preference for cool, well-oxygenated, rainforest streams.

In contrast to the unarmed rostrum of *C. parvus*, all highland New Guinean species, except *C. monticola*, have two or more pairs of lateral processes (tubercles or spines) on the rostrum. In *C. monticola* there is generally one or two pairs,

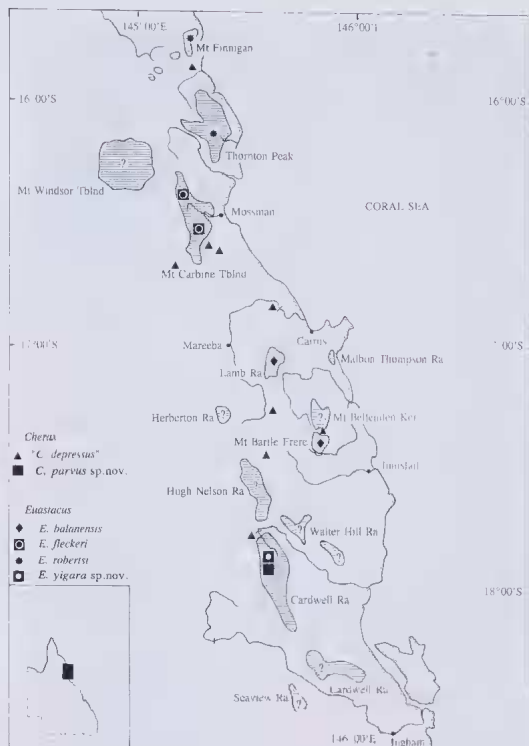


FIG. 5. QM locality records of freshwater crayfish in the humid tropics. Hatched areas are cloudy wet mountains inferred as major refugia (Webb & Tracey, 1981). Question marks indicate poorly-sampled refugial areas on which future investigations should focus.

but occasionally none or three. This species, however, has two well-defined uncalcified patches on the first cheliped of mature males and is clearly allied to the *quadricarinatus* species-group (Short, 1991).

KEY TO QUEENSLAND *CHERAX*

- 1 Adult rostrum with obvious, well-developed spines on lateral carinae; cervical groove of adults bordered by number of well developed spines ..... 2
- Adult rostrum without well-developed lateral spines, lateral carinae terminating in blunt process or unarmed; cervical groove bordered by blunt tubercles or small spines ..... 4
- 2(1) Rostrum with 1 pair of lateral spines; lateral pollex of first chelipeds of mature males without uncalcified region. .... *C. dispar* Riek, 1951 [Body bluish or green-grey, chelipeds dark blue in mature specimens, lighter blue ventrally, chelae orange in juveniles. Between Elliot R. & Brisbane R., SEQ, including large sand islands. Permanent freshwater, including

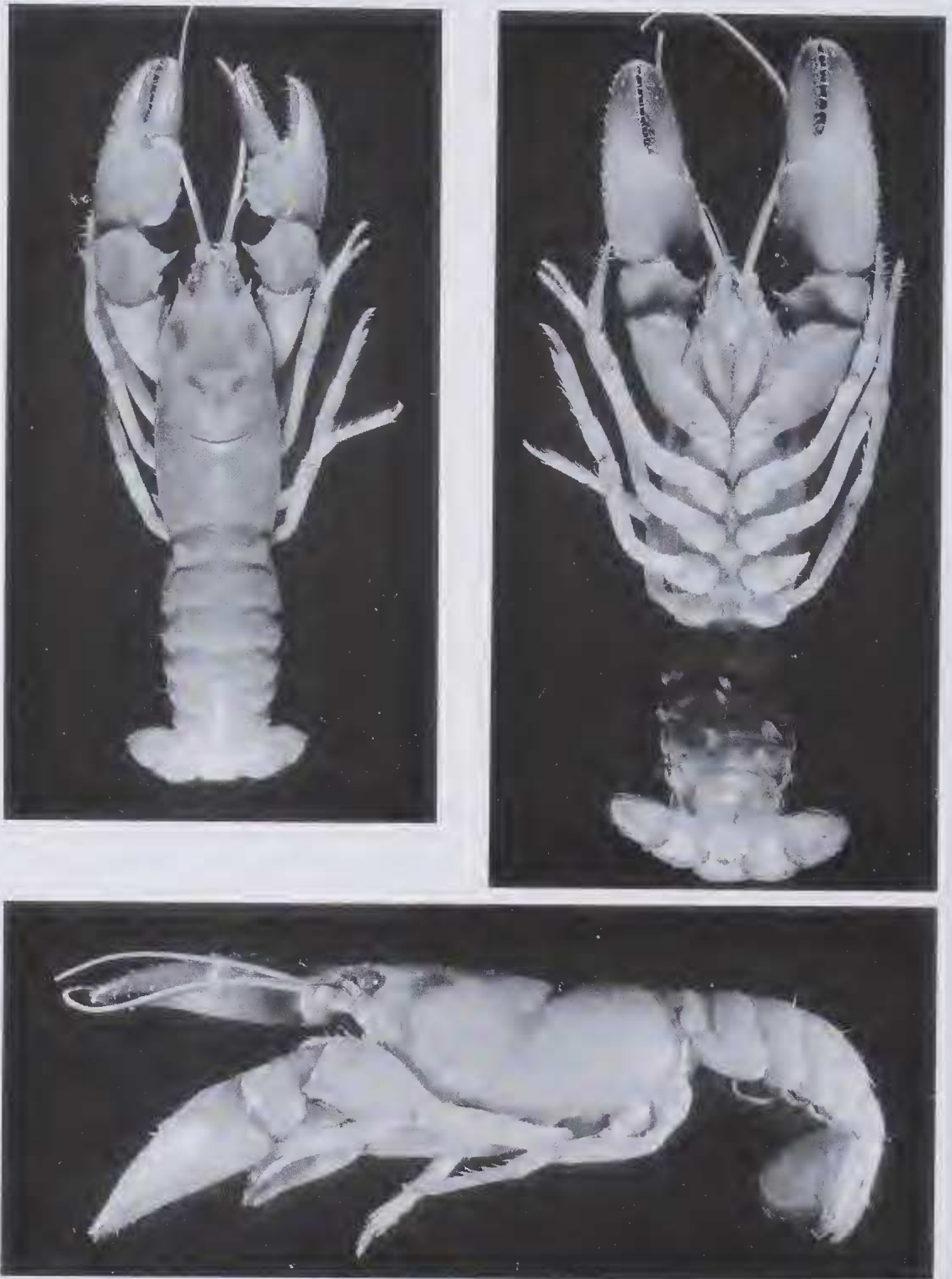


FIG.6. *Euastacus yigara* sp.nov., QM 18134, ♀ holotype (22.9 mm OCL).

acidic perched lakes and large coastal streams. Short burrows in, or connected to open water.]

- Rostrum with 2 or more pairs of lateral spines; lateral pollex of first chelipeds of mature males with distinct uncalcified region (most developed in fully grown males) ..... 3

3(2) Post-rostral carinae short, terminating slightly behind line of post-orbital spines; dorso-medial rostrum slightly concave, lateral carinae moderately elevated ..... *C. rhynchotus* Riek, 1951  
[Body green-brown dorsally, chelipeds similar except lateral chela orange, and uncalcified portion on lateral pollex of mature males peach cream. Northern Cape York Pen. and Badu Is., Torres Strait. Acidic coastal swamps and perched lakes. Burrows connected to open water or water table.]

- Post-rostral carinae long, almost extending to end of post-orbital carinae. Dorso-medial rostrum strongly concave, lateral carinae well elevated ..... *C. quadricarinatus* (von Martens, 1868)  
[Body colour from light green-blue to almost black, light flecks on lighter specimens, abdomen with purple bands dorso-laterally, chelipeds slightly darker than body, manus patterned dorsally, base of dactylus white, uncalcified portion on pollex of mature males red. Exorheic drainage systems from Daly R. N.T., to Normanby R., NEQ. Permanent freshwater, absent from acidic swamps and perched lakes. Short burrows in, or connected to open water.]

4(1) Antero-dorsal carpus of first chelipeds with condyle developed into long sclerotinous plate; post-orbital carinae commencing very close to carapace margin; adults with branchiostegites not obviously inflated ..... *C. parvus* sp.nov.  
[Dorsum dark brown, chelipeds dark brown disto-dorsally, patterned on dorsal manus, finger tips orange, proximal segments orange. Upper Tully R. catchment, NEQ. Rainforest streams. Short burrows in open water.]

- Antero-dorsal carpus of chelipeds with condyle typically developed into rounded lobe; post-orbital carinae widely separated from carapace margin; adults with branchiostegites obviously inflated ... 5

5(4) Branchiocardiac grooves well defined on adults, very narrowly separated or confluent anteriorly; mesial margin of manus of cheliped generally very short, much shorter than dactylus .....  
..... *C. punctatus* Clark, 1936  
[Mary R. catchment, SEQ. Burrows independent of open water or the water table, located on clay hillsides.]

- Branchiocardiac grooves variably defined on adults, when present well separated throughout length; mesial margin of manus of cheliped of moderate length, about equal in length to, or slightly shorter than, length of dactylus ..... 6

6(5) Serrations on manus of chelipeds clearly terminat-

ing within proximal half of mesial margin .....  
..... *C. cartalacoolah* Short, 1993  
[Dorsum blue-grey to rusty brown, venter vivid purple or blue, meral/carpal joint red. Cape Flattery, NEQ. Coastal sand dune wetlands, acid water. Burrows connected to open water or the water table.]

- Serrations on manus of chela terminating at least halfway along mesial margin ..... 7

7(6) Setation on ventral pollex of chelipeds very broad, clearly continuing onto manus .....  
..... *C. robustus* Riek, 1951  
[Body bluish or purple-grey to black, chelae of similar colour dorsally, ventrally vivid purple or blue, joints red. Fraser Is. and Cooloola to N. Stradbroke Is. SEQ. Coastal sand dune wetlands, acid water. Burrows connected to open water or water table.]

- Setation on ventral pollex of chelipeds restricted to opposing edge, not continuing onto manus ..... 8

8(7) Mesial surface of cheliped carpus usually with well developed setal pubescence; post-orbital processes obsolete ..... '*C. destructor*' complex<sup>1</sup>  
[Body from pale cream to brown or deep blue, chelipeds slightly darker with dorsal manus patterned, joints red. Wide-ranging inland and southern Australia; endorheic catchments, Murray-Darling system, and the Dawson R., MEQ. Permanent and ephemeral water bodies. Burrows in, or connected to open water.]

- Mesial surface of cheliped carpus without distinct setal pubescence, generally aetose, sometimes with scattered short setae; post-orbital processes moderately developed, spinate in juveniles, blunt in adults ..... '*C. depressus*' complex<sup>2</sup>  
[Body green-brown to blue-black or dark brown, often mottled in females, dorsal manus of chelae generally patterned, finger tips orange, joints red or orange. The Gold Coast, SEQ to Jardine Swamps, Cape York Peninsula. Ephemeral waters including acidic swamps. Burrows connected to open water or the water table.]

<sup>1</sup> Includes the nominal species, *C. davisi* Clark, 1941 and *C. destructor* Clark, 1936, in Queensland.

<sup>2</sup> Includes the poorly-defined nominal species, *C. depressus* Riek, 1951 and *C. cairnsensis*, *C. gladstonensis*, *C. wasSELLI* and *C. urospinus*, all of Riek, 1969.

### *Euastacus yigara* sp.nov. (Figs 6-8)

#### MATERIAL EXAMINED

HOLOTYPE: QM W18134, ♀ (22.9 mm OCL), O'Leary Ck, 17°50.7'S, 145°37.7'E, freshwater, rocks/sand, leaf litter, fallen timber, fringing simple notophyll vine forest, under rock in pool along edge of creek, pH 5.5, hardness <10 ppm, water temperature 20°C, dissolved oxygen 6 ppm, altitude c. 750 m, water depth 0.1-0.5 m, 07/11/1992, J. Short, P. Davie.

PARATYPE: QM W18125, imm. (11.1 mm OCL), same

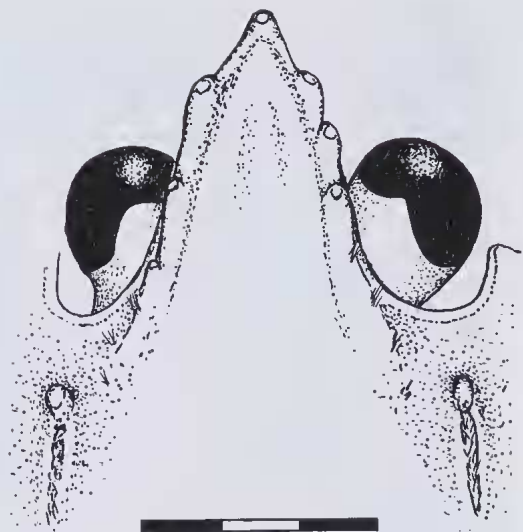


FIG.7. *Euastacus yigara* sp.nov., QM 18134, ♀ holotype (22.9 mm OCL), anterior cephalon and rostrum. Scale bar divisions in millimetres.

locality and habitat data as holotype, 06/11/1992, J. Short, P. Davie.

#### DESCRIPTION OF FEMALE HOLOTYPE

**Cephalothorax.** Carapace slender, breadth c. 0.5 X CL; cephalon with low, blunt, anteriorly-directed tubercles anterolaterally, extending in a band ventrally; thorax punctate, punctations bearing short setae, armed with 1-2 low cervical tubercles, otherwise smooth.

Rostrum moderately long, acute, basally broad, length c. 1.2 X breadth, reaching base of anten-

nular flagella; acumen spinous, upturned, sclerotinous at tip; lateral carinae well developed, slightly convex, armed with 3-4 pairs of blunt processes (more prominent and acute in juvenile paratype), processes diminishing in size posteriorly (3 on right side, but with no trace of fourth; on left side second spine missing but fourth present at about level of posterior edge of cornea), extending onto proximal half of rostrum; rostral carinae extending posteriorly to about half distance between posterior margin of orbit and post-orbital spine.

Post-orbital carinae long, sulcate, sulci setose, margins raised, armed with single blunt spine anteriorly. Branchiocardiac grooves distinct, relatively widely separated, areola divergent anteriorly.

Antennal scaphocerite with lateral margin straight, unarmed, apex acute, greatest breadth at mid-length; basicerite spine (suborbital spine) moderately developed; coxocerite with 2 small acute processes (on right), 1 small acute process and 2 more indistinct processes (on left); basal exopod spine (basipodite spine) absent. Epistome (interantennal spine) moderately elongate with weakly scalloped margins, reaching distal end of first segment of antennal endopod.

Sternal keel lacking spines; Pr1 posterior margin sloped, processes apart and parallel; Pr2 apart and open; Pr3 with posterior edges straight, or very slightly rounded; Pr4 with anterior edges angular, posterior borders sharp and convex.

**Chelipeds.** Moderately stout, dimorphic, left larger and more robust than right; left cheliped

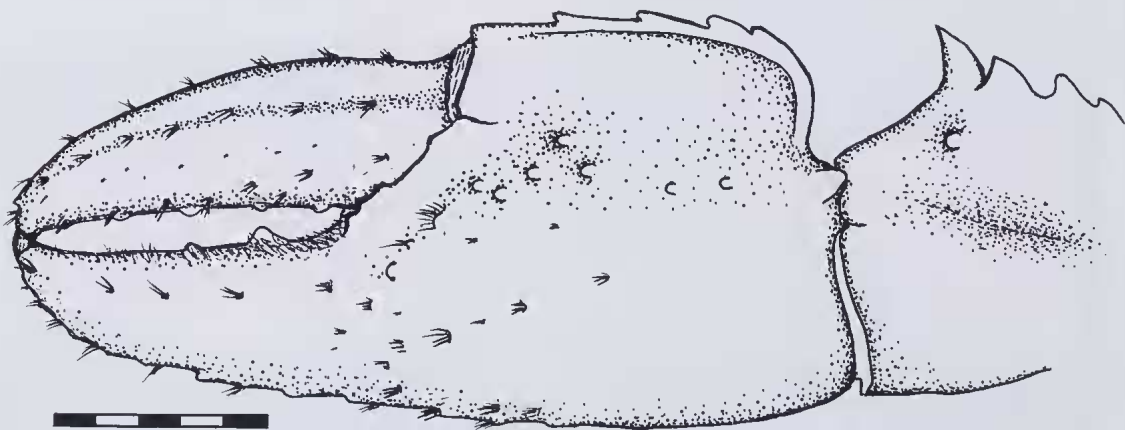


FIG.8. *Euastacus yigara* sp.nov., QM 18134, ♀ holotype (22.9 mm OCL), dorsal left chela. Scale bar divisions in millimetres.



dactyl length c. 0.6 X propodus length; propodus length c. 2.1 X width.

Dactylus without spines above tuberculate opposing edge, bearing small apical mesial spine, mesial basal spines absent, dactylar groove deep.

Propodus with single lateral spine row, spines blunt, becoming more prominent and closer together distally, not formed into distinct ridge; ventral spine row vestigial, single blunt mid-lateral spine; 5 marginal mesial spines; dorsal apical spines absent; without spines above opposing edge, opposing edge with single prominent rounded tubercle at about proximal quarter; 1 small distinct tubercle and 2 smaller indistinct tubercles on base of dorsal pollex lateral to dactylar base; unc ven row of tubercles dorso-medially on manus, ventral pollex with 1-2 tubercles lateral to dactylar base.

Carpus with deep dorso-longitudinal groove; 3-4 mesial spines, distal-most the largest and offset from remainder; minute lateral spine; articulation spine absent; small but prominent dorso-mesial tubercle inside longitudinal groove; minute disto-ventral process medially, 2 ventro-mesial processes, 1 slightly proximal to disto-ventral process the other placed below large distal carpal spine (processes much smaller on right cheliped).

Merus with 1-3 (1 on left, 3 on right) small dorsal spines; outer spine absent.

*Abdomen.* Bearing sparse short tufts of setae, smooth, punctate, second pleurae with 2 indistinct tubercles ventrally. Dorsal telsonic spines absent; surface anterior to small disto-lateral spines coarsely punctate, punctations bearing tufts of setae; posterior surface with fine longitudinal ridging.

#### COLOUR

General colour greenish-grey.

#### BIOLOGY

Freshwater, under rocks in shallow water (<0.5m), rocks/sand substratum, fringing simple notophyll vine forest, c. 750m altitude, water clarity high. Recorded physico-chemical tolerances: pH 5.5, hardness <10 ppm, water temperature 18-20°C, dissolved oxygen 5.8-6.0 ppm.

At the type locality *E. yigara* is sympatric with *C. parvus* sp.nov., *Caridina zebra* Short, 1993 and an undescribed *Macrobrachium*.

#### DISTRIBUTION

Presently known from O'Leary Ck, a tributary

of the upper Tully R. above Koombaloo Dam, Cardwell Ra., NEQ.

#### SURVIVAL STATUS

Unknown. More data is required on the abundance and distribution of the species. The two type specimens were located during 2 days collecting in the upper Tully area and c. 4 man-hours at the type locality. The species may be more common at higher elevations as other north Queensland species are restricted to altitudes above 800 m (Morgan, 1991).

#### ETYMOLOGY

The aboriginal word for 'crayfish' in the Djirbal language group of the upper Tully R. area (Dixon, 1972). The specific epithet is to be treated as a noun in apposition.

#### SYSTEMATIC POSITION

*E. yigara* sp.nov. most closely resembles *E. balanensis* Morgan, 1988, which is known from the nearby Lamb and Bellenden Ker Ranges. It can be separated from that species by the following features:

1. An obvious tubercle on the disto-mesial carpus inside the longitudinal groove.

2. The presence of 3-5 distinct dorso-medial tubercles in an irregular longitudinal row on the manus, with small setose punctations anteriorly. In *E. balanensis* the dorsal manus is ornamented with broad punctations but is without elevated tubercles.

3. The rostrum armed with blunt marginal tubercles which extend onto the proximal half. On *E. balanensis* they are restricted to the distal half.

4. A relatively wider arcola which diverges anteriorly rather than having subparallel margins.

Fifteen species of *Euastacus* are now known from Queensland. The distribution of *Euastacus* species in the humid tropics and their close association with the cloudy, wet, mountain areas, inferred as refugial by Webb & Tracey (1981), is illustrated in Fig. 5. Question marks indicate poorly-sampled refugial areas on which future investigations should focus. Of particular interest are the Walter Hill, Herberton and Hugh Nelson Ranges, between the present distribution of *E. yigara* and *E. balanensis*.

#### KEY TO QUEENSLAND EUASTACUS (Modified from Morgan, 1991)

- 1 Well-defined, longitudinal groove on dorsal carpus of cheliped ..... 2

- Without well-defined, longitudinal groove on dorsal carpus of cheliped, at most with broad, shallow depression ..... 14
- 2(1) Large species with well-developed abdominal spines; large adults usually with distinct spines on thorax and/or telson and 2 spines on mesial carpus of cheliped..... 3
- Small species with reduced or absent abdominal spines; large adults with spines on thorax and telson absent or minute; 3 or more spines on mesial carpus of cheliped..... 6
- 3(2) No mesial basal spines on cheliped dactylus. .... *E. valentulus* Riek, 1951  
[Body deep green or green-brown. From Currumbin Ck SEQ to Clarence R., NSW. Wet sclerophyll forest and rainforest, 0-600m.]
- One or more mesial basal spines on cheliped dactylus ..... 4
- 4(3) Large adults with dorsal spines absent on thorax and absent or very small on telson. ....  
..... *E. sulcatus* Riek, 1951  
[Body bright blue, red or brown. East flowing streams from Logan R., SEQ, to Richmond R., NSW; also the Condamine R. flowing west. Wet sclerophyll forest and subtropical/rainforest, >300 m.]
- Large adults with distinct spines on thorax; spines on telson usually distinct and often large ..... 5
- 5(4) Large adults with distinct dorsal spine(s) on abdominal somites 2-4. .... *E. suttoni* Clark, 1941  
[Body very dark, spines on thorax and abdomen bright red. Severn R. and Dumaresque R., SEQ, flowing west, and Clarence R., NENSW, flowing east. Dry sclerophyll forest and heath, >680 m.]
- Large adults with dorsal spines absent on abdominal somites 2-4. .... *E. hystricosus* Riek, 1951  
[Body, including spines, deep green. Conondale and Blackall Ranges, SEQ. Wet sclerophyll forest and rainforest, >550 m.]
- 6(2) Spines above opposing edges of chelae in rows reaching almost full length of fingers; ventral spine row on lateral chelae well developed ..... 7
- Spines above opposing edges of chelae not reaching beyond mid-length of fingers and sometimes absent; ventral spine row on lateral chelae absent or poorly developed (fewer than 4 spines) ..... 9
- 7(6) Post-orbital spine absent; 1st processes of sternal keel well separated and converging anteriorly .....  
..... *E. monteithorum* Morgan, 1989  
[Body and chelipeds dark brown dorsally except for orange merus, ventral body orange. From Kroombit Ck, Kroombit Tops, Calliope Ra., SEQ. Rainforest, >800 m elevation.]
- Post-orbital spine present; 1st processes of sternal keel close and parallel ..... 8
- 8(7) Numerous tubercles on dorsal and ventral surfaces of chelae near base of pollex, extending some distance along finger; without dorso-mesial tubercle on carpus of cheliped. ....  
..... *E. bindal* Morgan, 1989  
[From North Ck, Mt. Elliot, NEQ. Rainforest, 1000 m.]
- Only a few tubercles near base of fingers, these not extending along pollex; dorso-mesial tubercle/s present on carpus of cheliped. ....  
..... *E. eungella* Morgan, 1988  
[Body green-blue with purple tinges, especially on chelae. Tributaries of Pioneer R, Clark Ra., MEQ. Rainforest, >740 m.]
- 9(6) First processes of sternal keel apart ..... 10
- First processes of sternal keel close together ..... 11
- 10(9) Carpus of cheliped with dorsal disto-mesial tubercle, manus with irregular longitudinal row of dorso-medial tubercles; rostrum with marginal processes extending onto proximal half. ....  
..... *E. yigara* sp.nov.  
[Body green-grey. O'Leary Ck, tributary of upper Tully R, Cardwell Ra., NEQ. Rainforest, 760 m.]
- Carpus of cheliped without dorsal disto-mesial tubercle, manus without dorso-medial row of tubercles; rostrum with marginal processes restricted to distal half. ....  
..... *E. balanensis* Morgan, 1988  
[Body green-brown or olive, abdominal spines paler brown or green. Lamb and Bellenden Ker Ranges, NEQ. Rainforest, >800 m.]
- 11(9) Suborbital spine large. .... *E. setosus* Riek, 1956  
[Body deep red-brown with green on chelae. Mt. Glorious, D'Aguillar Ra., SEQ. Rainforest, >500 m.]
- Suborbital spine medium-sized..... 12
- 12(11) Third sternal keel processes parallel. ....  
..... *E. urospinus* Riek, 1956  
[Body red-brown with green tinges. Conondale and Blackall Ranges, SEQ. Rainforest, >240 m.]
- Third sternal keel processes not parallel ..... 13
- 13(12) Adult epistome of moderate length, clearly shorter than first segment of antennal endopod. ....  
..... *E. maidae* Riek, 1956  
[Body orange-brown, chelipeds similar except for finger tips blue. Upper Currumbin and Tallebudgera Cks, SEQ. Rainforest, >150 m.]
- Adult epistome elongate, reaching to distal end of first segment of antennal endopod or beyond .....  
..... *E. jagara* Morgan, 1988  
[Flaggy Ck, Mistake Mts, SEQ. Rainforest, 900 m.]
- 14(1) Lateral ventral spine row on chelae poorly developed, usually 4-5 spines on mesial margin of manus; rostrum U-shaped on large specimens .....  
..... *E. fleckeri* (Watson, 1935)

[Body very dark green, thoracic and abdominal spines red. Mt. Carbine Tableland, NEQ. Rainforest, >1000m.]

- Lateral ventral spine row on chelae well developed and reaching apex of pollex; 6-9 spines on mesial margin of manus; rostrum usually triangular.  
 .....*E. robertsi* Monroe, 1977  
 [Body dull blue-purple. Mt Finnigan and Thornton Peak, NEQ. Rainforest, >1000 m.]

## DISCUSSION

The presence of four undescribed freshwater decapods in the upper Tully R. catchment, three of which appear endemic (the two crayfish species described above and an undescribed *Macrobrachium*), suggests something unique about the physiographic/climatic history of the area. Features which may have promoted speciation include:

1. A well-developed, physical, dispersal barrier in the form of Tully Falls, which is a sheer drop of 200 m. Potential crustacean competitors and predatory fish such as *Hephaestus fuliginosus* (Sooty Grunter), *Kuhlia rupestris* (Jungle Perch) and *Tandanus tandanus* (Eel-tail Catfish) are also isolated by this barrier.

2. The high, consistent, annual rainfall (2689 mm average at Koombuloomba Dam) and plateau topography, resulting in an unusually large, upland/highland catchment of permanent streams of high water quality and cool water temperature.

3. A cloudy, wet, rainforest environment which may have acted as a refugium during periods of climatic warming and decreasing rainfall. The Cardwell Ra. was listed by Webb & Tracey (1981) as one of their inferred refugial areas for the humid tropics.

4. The long, stable geological history of the Cardwell Range, which is largely granitic in composition (De Keyser, 1964). Neighbouring granite massifs such as the Lamb and Bellenden Ker Ranges are of Permo-Triassic origin (Wilmott et al, 1988). Unlike the nearby Atherton Tableland, there is presently no evidence of larva flows on the Cardwell Range during the Cainozoic (De Keyser, 1964).

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